

Claims

1. A method of forming a strained Si layer on a SiGe-on-insulator (SGOI) structure with a low stacking fault defect density, the method comprising the steps of:  
providing a Si-on-insulator (SOI) substrate having an unstrained Si layer (102) over  
5 an insulator (100);  
depositing (300) a first SiGe layer (104) on said Si layer;  
thermally mixing (302) said first SiGe layer with said Si layer to transform said first SiGe layer and said Si layer into a relaxed SiGe layer (106);  
thinning (304, 306) said relaxed SiGe layer; and  
10 depositing (310) a strained Si layer (112) on said relaxed SiGe layer.
2. The method in claim 1, wherein said process of thermally mixing said first SiGe layer with said Si layer comprises heating said first SiGe layer and said Si layer to approximately 1200°C-1300°C in an oxidizing environment.
- 15 3. The method in claim 1, wherein said thinning process non-selectively thins said relaxed SiGe layer (106) such that the Si and Ge within said relaxed SiGe layer are removed proportionately.
- 20 4. The method in claim 1, wherein said thinning process comprises an HIPOX oxidation at temperature range of 550°C-700°C, pressure range of 1ATM-50ATM, preferably 5ATM-20ATM.
5. The method in claim 1, wherein said thinning process comprises a steam oxidation at  
25 a temperature range of 550°C-700°C.
6. The method in claim 1, wherein said thinning process comprises an in-situ HCl etching process performed in an epitaxy chamber.
- 30 7. The method in claim 1, wherein said thinning process comprises a CMP process.
8. The method in claim 1, characterized in that said second thickness is less than 1000Å.

9. The method in claim 1, characterized in that said SGOI is more than 60% relaxed.

10. The method in claim 1, characterized in that said SGOI has less than  $1 \times 10^4 / \text{cm}^2$  of  
5 stacking fault defects.

11. The method in claim 1, characterized in that said second thickness is less than  $500 \text{ \AA}$ .

12. The method in claim 1, characterized in that said SGOI is more than 80% relaxed.  
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13. The method in claim 1, characterized in that said SGOI has less than  $1 \times 10^2 / \text{cm}^2$  of  
stacking fault defects.

14. The method in claim 1, wherein said thinning comprises an oxidation process and said  
15 method further comprises smoothing (308) said relaxed SiGe layer to reduce surface  
roughness of said SiGe (110).

15. The method in claim 14, wherein said smoothing comprises one of:  
a touch-up CMP;

20 an in-situ hydrogen bake and SiGe buffer layer growth before depositing said strained  
Si layer; and

heating said relaxed SiGe layer in a hydrogen environment with a mixture of gases of  
HCl, DCS and  $\text{GeH}_4$ , at temperature of  $700^\circ\text{C}$ - $900^\circ\text{C}$ .